

REMARKS

1. In response to the final Office Action mailed August 29, 2008, Applicants respectfully request reconsideration. Claims 1-7, 9-11 and 13-21 were last presented for examination. In the outstanding Office Action, all claims are rejected. By the foregoing amendments, claims 1, 2, 4 and 16 have been amended, and no claims have been cancelled or added. Thus, upon entry of this paper, claims 1-7, 9-11 and 13-21 will be pending in this application. Of these nineteen (19) claims, three (3) claims (claims 1, 9 and 16) are independent.

2. Based upon the above Amendments and following Remarks, Applicants respectfully request that all outstanding objections and rejections be reconsidered, and that they be withdrawn.

Drawings

3. Applicants thank the Examiner for indicating that the drawings filed on January 27, 2006, have been accepted for publication.

Claim Amendments

4. Applicants have amended claims 1, 2 and 4 to make the claims more readable. Applicants respectfully submit that these amendments have not been made in response to any objection or rejection. Applicants further submit that no new matter has been added, and that the amendments do not alter the scope of the claims.

Claim Rejections under 35 U.S.C. §102

5. The Examiner has rejected claims 1-2, 5-7, 9, 14-16 and 19-21 under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 7,206,418 to Yang *et al.*, (hereinafter, "Yang"). For at least the reasons discussed below, Applicants respectfully disagree.

6. Yang is directed to a wireless communication device having noise suppression capabilities. (*See*, Yang, col. 1, lns. 6-10.) In general, Yang discloses a device which receives two sound signals and converts these signals into a single output having reduced noise therein. (*See*, Yang, col. 2, lns. 13-53.) More specifically, the device of Yang uses two microphones to detect the sound signals that each comprise a speech component and a noise component. (*See*, Yang, col.

4, lns. 64-67.) The two detected signals are each provided to a first and a second beam forming unit. (*See*, Yang, col. 5, lns. 1-7.) The first beam forming unit processes the two microphone signals to provide a first signal $s(t)$ which comprises a speech component and a noise component. (*See*, Yang, col. 5, lns. 8-21.) The second beam forming unit processes the two microphone signals to provide a second signal $x(t)$. (*See*, Yang, col. 5, lns. 22-29.) This second signal $x(t)$ is comprised mostly of the noise component so as to “provide an accurate estimate of the noise.” (*See*, Yang, col. 5, lns. 22-29.) The second beam forming unit is configured to block as much of the desired speech signal as possible from the second signal $x(t)$. (*See*, Yang, col. 5, lns. 22-29.) Signals $s(t)$ and $x(t)$ are ultimately provided to a noise suppression unit for further processing. (*See*, Yang, col. 2, lns. 30-53.)

7. Various embodiments of a noise suppression circuit are disclosed in Yang. (*See*, Yang, FIGS. 2, 4-6; col. 9, ln. 35- col. 12, ln 52.) In the outstanding Office Action, the Examiner relies upon the specific embodiment described with reference to FIG. 4 to reject Applicants’ claims under §102. (*See*, Office Action, pgs. 3-6.) In order to properly respond to the Examiner’s rejections, Applicants provide below a summary of the noise suppression circuit described with reference to FIG. 4 of Yang. Applicants further detail how this embodiment of Yang fails to anticipate or render obvious Applicants’ claimed invention. Although not discussed further herein, it should also be appreciated that Applicants’ claimed invention is equally patentable over all other embodiments of Yang.

8. In the embodiment of FIG. 4, the noise suppression unit comprises a pre-filter 432, voice activity detector 440, filter 450, summer 434 and spectrum subtraction unit 460. (*See*, Yang, col. 9, lns. 40-49; Figure 4.) The speech plus noise signal $s(t)$ is provided to the pre-filter 432 to remove high frequency components, and this filtered version of $s(t)$ is provided to the summer 434. (*See*, Yang, col. 9, lns. 40-49.) The mostly noise signal $x(t)$ is provided to the filter 450. The filter 450 “filters the noise with a particular transfer function $h(t)$ ” which “describes the correlation between the noise components received on $s(t)$ and $x(t)$.” (*See*, Yang, col. 9, lns. 40-49; col. 10, lns. 3-18.) When the signal $x(t)$ is provided to the filter 450, the filter “filters the mostly noise signal $x(t)$ with the transfer function $h(t)$ to provide the filtered noise $p(t)$, which is an estimate of the noise in the signal $s(t)$.” (*See*, Yang, col. 10, lns. 3-18.) Using summer 434, the estimated noise $p(t)$ is then subtracted from the filtered version of $s(t)$ “to generate the

intermediate signal $d(t)$.” (See, Yang, col. 10, lns. 3-18.) The intermediate signal $d(t)$ “represents the error between the between the noise received on the signal $s(t)$ and the estimated noise $p(t)$.” (See, Yang, col. 10, lns. 3-18.) Intermediate signal $d(t)$ is then provided to a spectrum subtraction unit (460). (See, Yang, col. 10, lns. 3-18.)

9. Yang’s spectrum subtraction circuit 460 is designed to use intermediate signal $d(t)$ to provide an output signal $y(t)$ that is predominately speech, and which has a large amount of the noise removed there from. (See, Yang, col. 10, lns. 19-24.) Spectrum subtraction circuit 460 is essentially an additional noise suppression unit that is implemented as described with reference to FIG. 2 of Yang. (See, Yang, col. 10, lns. 19-24.) The details of spectrum subtraction circuit 460 are not relevant to the following discussion and, as such, are not described further herein.

Claim 1

10. Applicants’ claim 1 is directed to a “method of reducing noise in a speech signal.” (See, Applicants’ claim 1, above.) The method comprises: outputting “a speech reference signal comprising a desired signal and a noise contribution, and at least one noise reference signal comprising a speech leakage contribution and a noise contribution; applying a filtering operation to said at least one noise reference signal; and subtracting from said speech reference signal said filtered at least one noise reference signal to provide an output version of said speech signal having reduced noise therein.” (See, Applicants’ claim 1, above.) The “filtering operation of said at least one noise reference signal is performed with one or more ***filters having filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal.***” (See, Applicants’ claim 1, above.) The “speech distortion energy” is the “energy of said speech leakage contributions” and the “residual noise energy” is the “energy of said noise contributions in said speech reference signal and in said at least one noise reference signal.” (See, Applicants’ claim 1, above.)

11. Applicants’ claim 1 was first rejected in view of Yang in the non-final Office Action mailed January 31, 2008 (hereinafter, “prior Office Action”). Applicants timely filed a response to the non-final Office Action on June 2, 2008, (hereinafter, “Applicant’s prior Response”), in which Applicants argued that the filters of Yang are only used to filter the input signal into first and second signals, to filter out high frequency components, or to apply a transfer function to a

signal. (*See*, Applicants' prior Response, pgs. 9-11, citing Yang, col. 9, lns. 40-49.) Applicants then asserted that one of ordinary skill in the art would not consider these filtering operations of Yang as equivalent to "a filtering operation... [of] at least one noise reference signal... whereby said filtering operation... is performed with one or more filters ***having filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal***" as recited in Applicants' claim 1. (*See*, Applicants' prior Response, pgs. 9-11.)

12. In the outstanding Office Action, the above arguments were deemed unpersuasive. Specifically, the Examiner asserts that filter 450 disclosed in FIG. 4 of Yang is a filter "having filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal" as recited, in part, in Applicants' claim 1. (*See*, Office Action, pgs. 3-4.)

13. For at least the following reasons, Applicants respectfully disagree, and respectfully assert that filter 450 of Yang is not equivalent to a filter "***having filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy*** in said output version of said speech signal" as recited, in part, in Applicants' claim 1. As recited in claim 1, the "speech distortion energy" is the "energy of said speech leakage contributions" and that the "residual noise energy" is the "energy of said noise contributions in said speech reference signal and in said at least one noise reference signal." (*See*, Applicant's claim 1, above.) Therefore, the filter recited in claim 1 is configured to minimize a "weighted sum" of both the "energy of... speech leakage contributions" and the "energy of... noise contributions in said speech reference signal and in said at least one noise reference signal." (*See*, Applicant's claim 1, above.) This is a specific filtering operation which considers energy of speech leakage and noise, and which filters the signal so that the weighted sum of those factors are minimized in the output signal.

14. It is well recognized that "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." (*See*, MPEP §2131.01, quoting *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987).) The MPEP makes it clear that for a *prima facie* rejection under

35 U.S.C. §102, “[t]he identical invention must be shown in as complete detail as is contained in the... claim.” (See, MPEP §2131.01, quoting *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236 (Fed. Cir. 1989); emphasis added.) Applicants assert that Yang fails to satisfy these legal requirements for at least the reason that Yang fails to either expressly or inherently disclose a filtering operation as described with reference to claim 1.

15. As noted above, filter 450 of Yang “filters the noise with a particular transfer function $h(t)$.” (See, Yang, col. 9, lns. 40-49.) The transfer function $h(t)$ “describes the correlation between the noise components received on $s(t)$ and $x(t)$.” (See, Yang, col. 10, lns. 3-18.) When the signal $x(t)$ is provided to filter 450, the filter “filters the mostly noise signal $x(t)$ with the transfer function $h(t)$ **to provide the filtered noise $p(t)$, which is an estimate of the noise in the signal $s(t)$.**” (See, Yang, col. 10, lns. 3-18; emphasis added.) It is clear from this disclosure that Yang fails to expressly disclose that filter 450 is equivalent to a filter “having filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal” as recited, in part, in Applicants’ claim 1. It should be appreciated that the “transfer function” of Yang is used to identify the noise present in $x(t)$ so as to provide an estimate of the noise present in the speech signal $s(t)$. As such, the “transfer function” does not expressly describe any type of filter configured to “minimize a weighted sum,” let alone a filter configured to “minimize a weighted sum of the speech distortion energy and the residual noise energy” in an output signal as recited, in part, in Applicants’ claim 1.

16. Furthermore, the use of a transfer function to filter a noise signal does not inherently describe a filter “having filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal” as recited, in part, in Applicants’ claim 1. As is well known in the art, a “transfer function” provides a mathematical relationship between an input to a filter and an output of the filter. There are various mathematical relationships that may be provided by a transfer function, and it does not necessarily or inherently follow that a transfer function minimizes “a weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal.” (See, Applicants’ claim 1, above.) In fact, the disclosure of Yang would lead one to find that the disclosed transfer function filters the noise signal in an entirely different manner

then the claimed filter. Yang states that filter 450 is implemented with a base filter. (See, Yang, col. 9, ns. 40-61.) “The base filter may be implemented as a finite impulse response (FIR) filter, an infinite impulse response filter (IIR),” etc. None of these filters disclosed in Yang have “***filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy.***”

17. Furthermore, the Examiner recognizes that Yang fails to show that the “speech distortion energy” is the “energy of said speech leakage contributions” and that the “residual noise energy” is the “energy of said noise contributions in said speech reference signal and in said at least one noise reference signal” as recited, in part, in Applicants’ claim 1. (See, Office Action, pg. 4.) However, the Examiner asserts that Yang discloses noise in the speech signal $s(t)$ and speech in the predominately noise signal $x(t)$, and discloses “minimizing the error with noise included for both the noise receive signal and estimated noise.” (See, Office Action, pg. 4.) As such, the Examiner asserts that “it is inherent of such existence wherein said speech distortion energy being the energy of said speech leakage contributions and said residual noise energy being the energy being the energy of said noise contributions in said speech reference signal and in said at least one noise reference signal.” (See, Office Action, pg. 4.) Applicants respectfully assert that even if such energy is present in the signals of Yang, it is still improper to assert that filter 450 of Yang is equivalent to the filter of claim 1. As noted above, there is no express or inherent teaching in Yang demonstrating that filter 450 operates to “minimize a weighted sum of the speech distortion energy and the residual noise energy” and it is entirely likely that filter 450 of Yang operates in a manner that does not perform this specific function.

18. Without some additional disclosure or teaching in Yang, Applicants asserts that it is improper for the Examiner to assert that Yang expressly or inherently describes a filter “***having filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy*** in said output version of said speech signal” as recited, in part, in Applicants’ claim 1. (Emphasis Added). As such, Applicants assert that the rejection of claim 1 is improper and should be withdrawn.

19. As detailed above, the Examiner has not provided any sound basis or support to justify the assertion that Yang expressly or inherently teaches a filter “having filter coefficients

configured to minimize a weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal” as recited, in part, in Applicants’ claim 1. Therefore, it is clear that the Examiner is relying on information within the personal knowledge of the Examiner. Accordingly, Applicant requests that the Examiner provide an Affidavit/Declaration under 37 C.F.R. § 1.104(d)(2) supporting the statements of fact that are within the personal knowledge of the Examiner and upon which the Examiner has relied on in finding that Yang teaches the above elements of claim 1.

Claim 9

20. Applicants’ claim 9 is directed to a “signal processor for reducing noise in a speech signal.” (*See*, Applicants’ claim 9, above.) The signal processor of Applicants’ claim 9 comprises “a second filter configured to filter said at least one noise reference signal...wherein said second filter has filter coefficients configured to minimize a weighted sum of the energy of said speech leakage contribution and the energy of said noise contributions in said output version of said speech signal.” (*See*, Applicants’ claim 9, above.) For at least the reasons discussed above with reference to claim 1, Applicants assert that Yang fails to anticipate or render obvious at least these elements of claim 9. Specifically, as noted above, the filters of Yang are merely used to initially filter an input signal into multiple components, filter out high frequency components, or to apply a transfer function to a signal, and completely fail “to minimize a weighted sum of the energy of said speech leakage contribution and the energy of said noise contributions” as recited in claim 9, above. (*See*, Yang, col. 9, lns. 40-49.) As such, for at least these reasons, Applicants respectfully request that the rejection of claim 9 under 35 U.S.C. §102 be reconsidered, and that it be withdrawn.

Claim 16

21. Independent claim 16 is directed to a “signal processor configured to reduce noise in a speech signal.” (*See*, Applicants’ claim 16, above.) The signal processor of Applicants’ claim 16 comprises “a means for filtering said at least one noise reference signal... wherein said means for filtering said at least one noise reference signal is configured to minimize a weighted sum of the energy of said speech leakage contribution and the energy of said noise contributions in said output version of said speech signal.” (*See*, Applicants’ claim 16, above.) For at least the

reasons discussed above with reference to claim 1, Applicants assert that Yang fails to anticipate or render obvious at least these elements of claim 16. Specifically, as noted above, the filters of Yang are merely used to initially filter an input signal into multiple components, filter out high frequency components, or to apply a transfer function to a signal, and completely fail “minimize a weighted sum of the energy of said speech leakage contribution and the energy of said noise contributions” in the output signal as recited in claim 16, above. (*See*, Yang, col. 9, lns. 40-49.) As such, Applicants respectfully assert that claim 16 is patentable over the art of record.

Claim Rejections under 35 U.S.C. 103(a)

22. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yang in view of U.S. Patent No. 6,178,248 to Marsh, (hereinafter, “Marsh”). The Examiner has also rejected claims 3-4 and 10-11, 17-18 under 35 U.S.C. 103(a) as being unpatentable over Yang in view of U.S. Patent No. 6,449,586 to Hoshuyama, (hereinafter, “Hoshuyama”). Without addressing the apparent lack of motivation to combine Yang with Marsh or Hoshuyama, Applicants respectfully assert that the above rejections of Applicants’ claims are improper for at least the reason that the proposed combinations fail to anticipate or render obvious all elements of claims 3-4, 10-11, 13 and 17-18, respectively.

23. As noted above with reference to the rejection of claim 1 under 35 U.S.C. §102, Yang fails to teach that which the Examiner asserts. Specifically, Yang fails to teach or suggest “filter coefficients configured to minimize a weighted sum of the speech distortion energy and the residual noise energy in said output version of said speech signal” as recited, in part, in Applicants’ claim 1. Applicants further assert that Marsh and Hoshuyama fail to teach that which is missing from Yang.

24. Because dependent claims 3-4, 10-11, 13 and 17-18 incorporate the subject matter of their respective independent claims (1, 9 or 16), Applicants assert that Yang, Marsh and Hoshuyama, taken alone or in combination, fail render obvious all elements of Applicants’ claims. As such, Applicants respectfully assert that the rejections under 35 U.S.C. §103 are improper and should be withdrawn.

Dependent Claims

25. The dependent claims incorporate all of the subject matter of their respective independent claims and add additional subject matter, which makes them *a fortiori* and independently patentable over the art of record. Accordingly, Applicant respectfully requests that the outstanding rejections of the dependent claims be reconsidered and withdrawn.

Conclusion

26. In view of the foregoing, Applicants respectfully submit that this application is now in condition for allowance. A notice to this effect is respectfully requested.

27. Applicants make no admissions by not addressing any outstanding rejections or basis of rejections. Furthermore, Applicants reserve the right to pursue any cancelled claims or other subject matter disclosed in this application in a continuation or divisional application. Thus, cancellations and amendments of above claims, are not to be construed as an admission regarding the patentability of any claims.

Dated: January 21, 2009

Respectfully submitted,

/Michael G. Verga/
Michael G. Verga
Registration No.: 39,410
CONNOLLY BOVE LODGE & HUTZ LLP
1875 Eye Street, NW
Suite 1100
Washington, DC 20006
(202) 331-7111
(202) 293-6229 (Fax)
Attorney for Applicants